

GENETICALLY MODIFIED PRODUCTS IN LITHUANIA: SITUATIONAL ANALYSIS AND CONSUMERS' ATTITUDES

Dainora Grundey^{1*} and Indre Rimkiene²

¹⁾ *Mykolas Romeris University, Lithuania*

²⁾ *Aleksandras Stulginskis University, Lithuania*

Abstract

The paper analyses the genetically modified organism products (GMP) in relation to genetically modified organisms (GMO) from two perspectives: 1) from the theoretical standpoint, discussing the GMO and GMP trade conditions and 2) from the practical perspective, namely analysing the availability of GMP in the Lithuanian market. With the growing of genetically modified products (GMP) levels, it becomes important to examine the situation of genetically modified products. According to various studies on Lithuanian public opinion on genetic modification, genetically modified organisms and their products, we can provide for the future of GMOs in the Lithuanian market. Although there are different opinions about genetically modified products not only in Lithuania, but also throughout the world, the level of development in this area increases every year. This is one of the reasons for which it is necessary to know and explore the Lithuanian population, as the buyer of the genetically modified products, and to examine the Lithuanian market of these products. Although the market is limited for these products, it is still very important to know as much as possible about genetically modified organisms and their effects on humans and the environment, and the future of the people, as consumers have their own opinion about them.

Keywords: genetically modified organisms (GMO), genetically modified foods and products (GMP), agriculture in international trade, consumers' attitude, Lithuania

JEL Classification: Q13, Q17, Q18, P2

Introduction

In a very short time, biotechnology and genetics' revolution has achieved a major breakthrough seeking competitive advantage (Miron et al., 2011), diversification (Marinez-Campillo and Fernandez-Gago, 2011) and sustainable transformations of farming plots (Melnikas, 2011). Together with the life sciences, biotechnology-based economy, by offering prospects for the future (Toming, 2007), attracted various fields of science representing people's attitude and many farm fields ended up at the top in the twenty-first

* Corresponding author, **Dainora Grundey** - dainoragrundey@yahoo.co.uk

century, as the genetic change, genetic engineering, recombinant DNA (rDNA), has the ability to change the genetic material and provide the features, which could lead to the proliferation of the organism in a natural way (Grundey, 2003; Grundey et al., 2004). Gene-engineered organisms are usually referred to as the creation of genetically modified organisms (GMOs).

Transferring different types of genes into a genome of the same species (*by adding a transgenic gene*) leads to controversial discussions. Many people believe that science is trying to interfere with the reckless practices in nature, ignoring the many well-known natural genetic interbreeding. Some NGO activists are still working hard to ban GMOs altogether; other, meanwhile, call for the mandatory labelling of genetically modified food (Grinius et al., 2007). At the same time, the products on the market undergoing radical changes that are transforming food production, distribution and consumption areas. Those changes are directly related to commercial food products produced from genetically modified products in use.

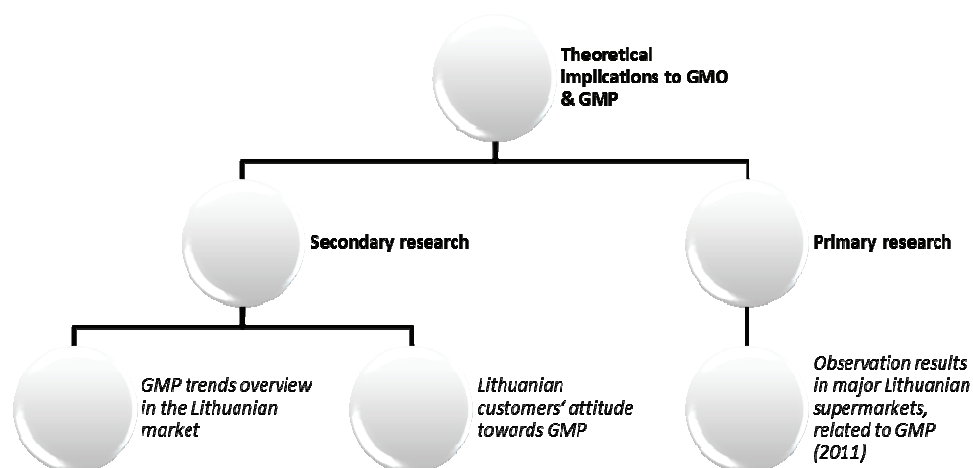
The research aim of the paper is to analyse the potential of genetically modified products in the Lithuanian market and their tendencies from a consumer's perspective. Therefore, the following *research tasks* of the paper are defined:

- to present theoretical implications of GMO and GMP (genetically modified products) with support of world-wide practices and attitudes towards the new biotechnologies;
- to define the presence of products containing genetically modified organisms on the Lithuanian market and to reveal their changes of content;
- to review Lithuanian consumers' attitudes and perceptions of GMO and GMP;
- to perform an empirical observation and compare the pricing policy of GMP at major Lithuanian supermarkets as compared standard products.

The research methods realised in the paper are as follows: logical analysis and synthesis of the academic and popular science literature, secondary research (the desktop method for aggregation and comparison analysis of Lithuanian consumers towards conventional and genetically modified products) and primary research (the observation method in the major Lithuanian supermarkets).

The logic of the current research is presented in figure no. 1. In *Section 1*, we will define the main trends in GMO technologies, evaluating the pros and cons of the phenomenon, considering European and world-wide practices, whilst approaching the situation on the Lithuanian market later, in *Section 2*.

Section 2 is dedicated to the secondary research results, performed in the desk research manner, studying GMP trends and GMO/GMO availability on the market, also defining research results of previous studies, performed on the subject of Lithuanian customers' attitude towards GMP and their purchasing prospects. *Section 3* contains the findings of our primary research, performed via the observation method in major Lithuanian supermarkets, researching the pricing tendencies of GMP in Autumn 2011. The paper is finalised with conclusions on the research subject.



Notes: GMO – genetically modified organisms; GMP – genetically modified products.

Figure no. 1: The Logic of the Current Research on GMO and GMP on the Lithuanian Market

1. Literature review: Pros and Cons of GMO Technologies

When genetically modified plants are used in the production process, genetically modified products (GMP) are being created¹. GMPs are widely used in various spheres of food production; therefore, Paulauskas (2004) classified GMPs according to the sphere of their application, as follows:

- genetically modified food products;
- genetically modified animal feed and additives;
- medical products, medication, containing GMO;
- veterinary drugs, equipment, containing GMO;
- GMO is used for limited applications and purposes, such as educational, research, development, and non-industrial activities;
- genetically modified products based on technical (non-food) plants;
- genetically modified products, based on animals, used for non-food industry.

The creation of such products was fostered by a sequence of scientific findings, including the discovery of the DNA molecule and finishing with the first recombinant bacteria (*E. coli*), expressing a frog's gene. In fact, such a genetically modified bacterium was identified as the first transgenic organism, which contained a bacterium of a different species, namely

¹ GMP – genetically modified product is an item, containing or consisting of genetically modified organisms (GMO): e.g., plants, animals, micro-organisms. According to EC Directive No 1830/2003, the following GMP can be listed: GMO produced as food (e.g., genetically modified soya beans), foods containing GMO (e.g., genetically modified soya oil), foods that are produced from GMO (e.g., soya cheese), foods, the constituent part of which can originate from GMO parts (e.g., chocolate, which contains lecithin, produced from genetically modified soya beans).

a frog's gene. In 1986, the first genetically modified plant gave rise in the USA, namely tobacco, resistant to herbicides. When speaking of foods, consumed by humans, we have the first commercial product on the market, dated 1993, when an official licence was issued for growing sugar beetroots, resistant to viruses. Later on, in 1994, the Californian company *Calgene* genetically modified tomato with improved qualities of much longer preservation date and it was introduced for mass consumption (Grinius et al., 2007).

According to Clive (2008), genetically modified crop fields for commercial purposes were steadily increasing by 15% per annum as from 1996. Thus, by 2008, such crops spread over 125 million hectares (63% in the USA only). From the international perspective, in 2008, 25 countries, involved in growing genetically modified plants, accounted for 8% of all international plots with GM crops; additionally, other 30 countries imported GM agricultural products for human food and animal feed (Clive, 2008).

Aleksynas (2006) noted that the comprehensive practice of agriculture demonstrates that only few transgenic agricultural plants are of wide-spread cultivation, namely soya beans, cotton plants, and corn². Fast increase in GM plant plots in developed and less developed countries indicate that farmers receive direct economic benefits from the new GM technologies.

The current progress, achieved in the field of GM plant creation for mass consumption, was defined by McHughen (2000) and Aleksynas (2006), who indicated agronomic features by GM species with positive influence on agriculture and food production (figure no. 2).

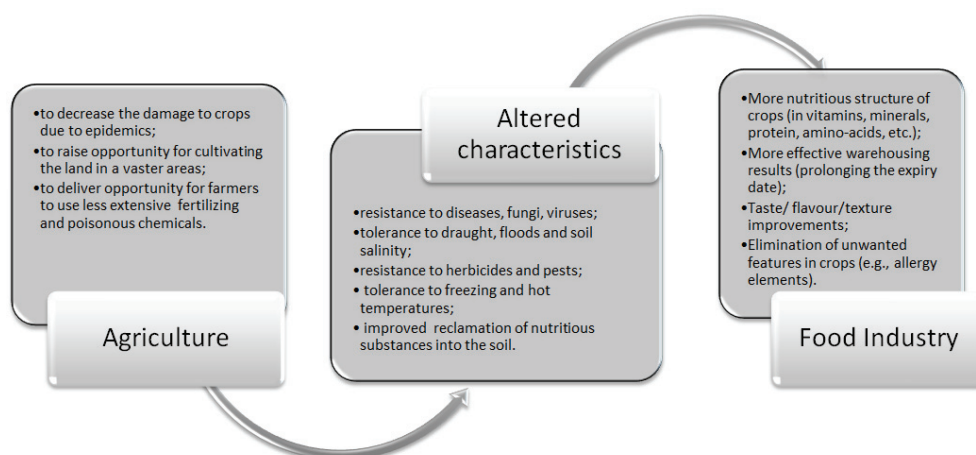


Figure no. 2: Positive influence of agriculture and food industry as a result of agronomically altered plant characteristics

Source: created by the authors after McHughen, 2000 and Aleksynas, 2006

² Soya beans, containing herbicide-resistant gene (glyphosate or glufosinate ammonium), are being grown in the plot of 65.8 million hectares worldwide, and consequently they comprise 70% of all soya plots in the world. GM cotton plants cover 37.3 million hectares worldwide. Such cotton plants are usually resistant to herbicides and pests. Genetically modified corn has similar features, and their plots extend to 15.5 million hectares in the world (Aleksynas, 2006; Clive, 2008).

Positive characteristics of plants can be successfully used not only for GM food and feed production, but also serve as bio-fuel, fibre products, etc. Such usage of bio-technologies encourages the development of sustainable development for the human well-being. Murphy et al. (2007), by evaluating the latest market trends in extending plots for GM plants and based on companies' reports, constituted that by 2015 approximately half of the world's agricultural production, intended for human food, animal feed or industrial materials will be grown by using one or more GM bio-technological plant types.

As Paulauskas (2004) indicated, there could be direct or indirect, fast or delayed GMO impact due to its increasing inflow into the market production and consumption. Stanys (2009) acknowledged that at the current state of arts not everything was perceived and researched properly to indicate the scope of risk, related to GM plat usage. Besides, there are questions and discussions towards the origin of such risks (table no.1): the organisms in question can easily spread in the eco-environment by causing irreversible changes for eco-systems. Even though scientific research findings and short-term agricultural and farming results do not point to such destructible threats, the authors of this paper identified a number of areas of GMO risks and potential consequences (table no. 1) from latest scientific sources. Table no. 1 demonstrates there major areas of GMO risks, related to 1) the environment; 2) human and fauna health, food/feed safety; 3) agriculture (food production economy).

One of the first scientists who broke the alert on GMO risks and the necessity to measure their outcomes was Moschini (2008). His idea was based on the assumption that genetic material can be transferred (or with time transfers itself) from one organism to another. Such processes might instigate unwanted and unknown toxins and allergens to multiply also causing long-term toxicology and allergies. It is also feared that GM plants' features³ might be transferred to other plants in natural environment. Finally, bio-genetic methods are treated as insecure when unrelated genes are inserted into organisms, as these methods have not been scientifically perfected and failed to guarantee security measures in trans-genic plant procedures.

Table no. 1: Areas of risk and consequences of GMO and GMP

Areas of risk	Consequences
Environment	<ol style="list-style-type: none"> 1. Decrease in some sorts of biological diversity (GMO competitive advantage, in comparison with unchanged recipients). 2. New GMO features overshadow other biological sorts co-existing in the same eco-system. 3. Extension of certain species, e.g., non-parasite insects, due to the toxins generated by GMO plants. 4. Transfer of genes between GMO populations and their wild counterparts; a possibility to transfer gained genes to other species; a risk of such species becoming immune to antibiotics, herbicides and pesticides. 5. Infection of the soil with genetically modified proteins and their impact on life populations of micro-organisms. 6. Manifestation of unexpected/unwanted features in modified organisms, which causes a threat to expansion of such populations in the environment, consequently affecting various levels of related populations of fauna and flora.

³ resistance to herbicides and insects/pests

Areas of risk	Consequences
Human and fauna health, food/feed safety	<ol style="list-style-type: none"> 1. Increase in cases of allergy to foods, produced from GMO, a threat of toxicosis. 2. Due to the transfer of GMO genes a human develops immunity to antibiotics under the impact of modified micro-organisms. 3. There is a threat that transgenic DNA might affect a human organism due to the consumed GM products. 4. A negative effect on human health might occur due to changed quantities of food stuffs in consumed GM products. 5. GMP might be pathogenic to consumers, who are immune only to naturally existing organisms; therefore, there is a probability to develop new and/or inherit existing diseases (illnesses).
Agriculture (food production economy)	<ol style="list-style-type: none"> 1. Transgenic impact from GMO to other crops. 2. Negative impact on farming productivity due to control costs of „super-weeds“. 3. Horizontal gene transfer or GM protein infiltration into the soil, impacting insects' resistance to insecticides; therefore, irreversibly destructing the crop plots. 4. Increasing farmers' dependency on GM seeds distributed by business conglomerates.

Source: compiled by the authors according to Abdalla et al., 2003; Batiuskaitė, 2007; Paulauskas, 2004; Stanys, 2009.

GMO opponents are determined to prove that the application of trans-genic procedures and their expansion create negative impact on the natural environment, their main argument being the uncontrolled and unwanted dissemination of modified genes (Gaidamavičius, 2007). For example, pesticide-resistant genes from GM plants might infiltrate into weeds or wild species of related nature by contaminating traditional or ecologic plants and their seeds⁴. Grinius et al. (2007) opposed such an attitude by stating that old local plant varieties are getting extinct in a natural way world-wide without GM plant interference. Grinius et al. (2007) claimed that the treat over „super-weeds“⁵ was over-exaggerated and non-substantiated.

There are some prevailing scientifically based opinions that GMO consumption might become the cause for various health problems. Most prominent GMO opponents in the world are considered to be Pusztai (1999) and Jermakova (2005) (Grinius et al., 2007). According to Grinius et al. (2007), Pusztai declared that during his experiments with rats irreversible harm was detected for their immune system as their development slowed down considerably due to their diet, which contained genetically modified potatoes with lacteal from snowdrop genes. Synthetic lacteal available in GM potatoes is toxic to insects,

⁴ In some Australian regions, where no GM crops were grown, modified cornflowers were detected, which, consequently, became immune to herbicide glyphosate (Abdalla et al., 2003). In Mexico, scrupulous research revealed that locally grown corn types were already contaminated with genetically modified *Bt* corn gene. Therefore, full-scale farming of modified plants might become the cause for extension of local species, which currently pertain valuable features of complex local varieties (Aleksynas, 2006).

⁵ Despite the method, which is used for fighting against weeds, the weeds, which survive the process, become resistant to this method and become so-called „super-weeds“. Resistance to herbicides is an old problem, the solution to which is new forms of herbicides, despite the technologies applied.

invertebrate organisms and mammals⁶. Independent experts came up with the verdict that the research findings were inconsistent and insufficient to make far-reaching conclusions. In Russian scientist Jermakova's (2005) case, she had no official publications in peer-reviewed scientific journals on her research⁷ findings; and the National Health Institute in the USA presented no scientific substantiation to repeat and validate I. Jermakova's experiment (Grinius et al. 2007).

Thus, Grinius et al. (2007) considered that it was not rational to cite A. Pusztai and I. Jermakova's publications as scientific proof of harmful GM food effects. It is also important to note that a lot of organisations world-wide, such as World Health Organisation, *Friends of The Earth*, and Science Academies in various countries put their efforts in analysing GMP safety; and they claim that no concrete evidence has been received on breaching safety for GMO and GMP. Scientists came up with a cautious conclusion that GMO and GMP were slightly risky for consumption, but the risk is under control.

Abugelis (2006) points out that one more threat related to bio-technologies can be detected, namely the increasing dependency of farmers on large bio-technological conglomerates. It is considered that GMOs bring the biggest portion of profits to multinational companies which develop and sell GM products. Farmers, who grow patented GM plants, are not allowed to use their harvested seeds for the next year's sowing; therefore, all is controlled by private bio-technological companies.

Application of bio-technologies might have positive and negative effects to social, economic and ecological environment, as well as direct costs and benefits to private producers and individual consumers. Despite potential benefits, various countries face considerable barriers in adapting and using biotechnologies in practice. *Firstly*, the scope of green bio-technological products (especially food) is determined by *consumers' attitude*, especially related to their *preferences and the level of acceptance* of new bio-technologies. *Secondly*, consumers' attitudes also depend on *information availability* on biotechnological progress, harm, safety and risk criteria in the consuming process and health-related issues. Rousu et al. (2007) and Knight et al. (2007) in their market research findings indicated that *consumers' perception and opinion* on GMO and GMP is directly connected with information flows. The nature and content of such information has direct impact on consumers' perception of the GMP value.

2. Genetically Modified Products for consumption on the Lithuanian market

Despite the strong EU's position on GMOs and GM products containing such organisms, the Lithuanian market offers a variety of GM products for its consumers. In 2007, Lithuania had 38 titles of genetically modified foods, namely: 22 types of vegetable oil, 8 kinds of desserts, 6 varieties of margarine and 2 varieties of mayonnaise (table no. 2). In 2009, the State Food and Veterinary Office of the Republic of Lithuania estimated 44 names of genetically modified foods, based on product labelling, which indicated that the product contained GMOs (table no. 2).

⁶ When the research findings were published in *Lancet*, the evidence on harmful effects on rats' immune system and their slow-down in development was not sufficient (Grinius et al., 2007).

⁷ Experiments with trans-genetic soya and their harmful effects on laboratory rats.

In 2009, vegetable oils (22 varieties), made from GM soya beans, were the major part of GM food products on the Lithuanian market. Other products, such as *margarine*, *mayonnaise*, *fat spreads*, which were imported to Lithuania with 11 product names, contained GM soybean oil. Lithuanian supermarkets also offered desserts, confectionary and toasted bread containing GM soya and food additives.

In July 2010, the State Food and Veterinary Office established the list, where 163 titles of genetically modified foods (*product labels indicated that they contained GMOs*) were available on the Lithuanian market (table no. 2). In less than two years, the number of GM foods on the Lithuanian market increased by 3.7 times.

**Table no. 2: Number of genetically modified food products
on the Lithuanian market in 2007, 2009-2011**

The type of a product	2007	2009	2010	2011
VEGETABLE OILS (produced from genetically modified (GM) soya beans or containing oil from genetically modified soya beans)	22	22	24	26
MARGARINE, FAT SPREADS (containing oil produced from GM soya beans)	6	7	7	7
DESSERTS (containing GM soya products)	8	10	31	43
MAYONNAISE (containing soybean oil, produced from GM soya bean)	2	3	1	1
FOOD ADDITIVES (containing GM soya products)	-	1	3	-
TOASTED BREAD (which was fried in soybean oil, produced from GM soya bean)	-	1	1	2
OTHER FOODS PRODUCTS	-	-	96	97
TOTAL:	38	44	163	176

Source: compiled by the authors after the data from the State Food and Veterinary Authority of the Republic of Lithuania, 2007, 2009, 2010, 2011.

The State Food and Veterinary Office (SFVO) are active in controlling genetically modified food issues in Lithuania, related to genetically modified raw materials, their traceability and identification in labelling, carrying out risk assessments. In July 2011, the data by SFVO was issued, stating that: 1) 26 items of genetically modified vegetable oils derived from genetically modified soya beans or containing oil, produced from genetically modified soya beans, are being traded in Lithuania; as well as 2) 7 brands of margarine, fat spreads, which contain oil, produced from genetically modified soya beans; 3) 43 names of sweets, which contained genetically modified soya; 4) one brand of mayonnaise, which contained soybean oil made from genetically modified soya beans; 5) 2 toasted bread varieties, which were fried in soybean oil made from genetically modified soya beans; 6) 97 titles of culinary products, produced with vegetable oil based on genetically modified soya beans.

When comparing the quantity of GMPs on the Lithuanian market (using data of 2010 and 2011), an increase by 7.9% is observed. An in-depth examination of GMPs on the Lithuanian market during the last five years' period demonstrated that the supply of GMPs

increased by more than 4.6-fold. According to Jaroškienė (the specialist of Sanitary Veterinary and Food Department at SFVO), the list of genetically modified foods is not exhaustive, it is constantly changing as manufacturers constantly introduce new food products or additives containing genetically modified material to the market.

Trade in products containing GMOs in the European Union (EU) member states is unrestricted, but may only be marketed as defined in the EU declaration on plant variety of food products. In accordance with EU requirements, which must be respected, e.g., the *labelling of products and information about GMOs* should not necessarily be singled out, for example, in **bold** letters. According to the European and Lithuanian legislation, *information for consumers about genetically modified organisms in labelling must be only provided when a product contains more than 0.9% of GMO material* (Lietuvos respublikos genetiškai, 2001).

3. Overview of previous studies on consumers' attitude towards GMP in Lithuania

A series of commissioned surveys to investigate public knowledge and attitude towards GMO and GMP have demonstrated that Lithuanian citizens prevalingly have *negative attitudes* towards the development and production of GM related products on the local market.

Extensive surveys were carried out in 2007, 2009 and 2010 in Lithuania (figure no. 3) to determine the public opinion on GMOs and GMPs. These questionnaires aimed at three major research objects: a) what were the Lithuanian residents' attitudes towards the GMOs in respect to the identification of information (e.g., in product labelling practices); b) what was the Lithuanian residents' opinion on the GMO distribution channels (e.g. grown locally, in Europe or the USA); c) what were the main sources of public knowledge on GMOs and GMPs related to their origin, safety and short- and long-term health issues.

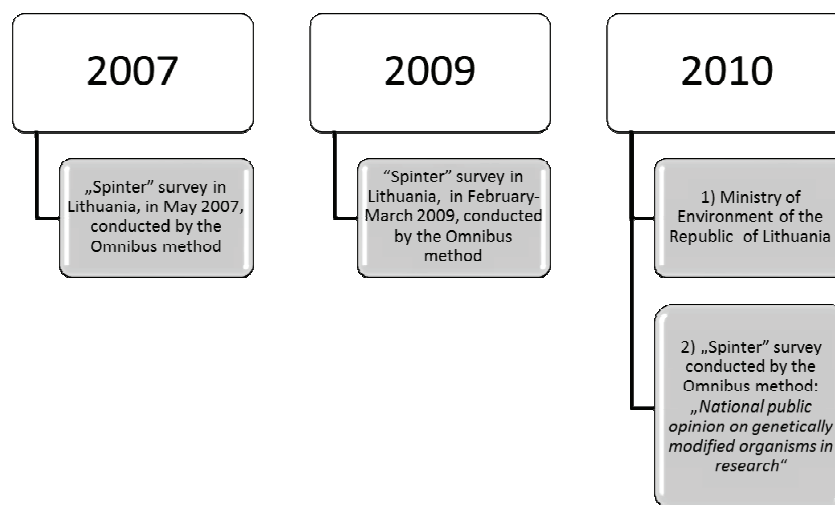


Figure no. 3: Surveys, carried out in Lithuania, to determine consumers' attitudes toward GMO and GMP, 2007, 2009-2010

Source: compiled by the authors

"Spinter" survey (May 2007). In May 2007, "Spinter" (a public opinion and market research company in Lithuania) conducted a survey related to GMOs amongst the Lithuanian population by applying the Omnibus survey method. The main result of the survey was a clear negative attitude of the Lithuanian citizens towards genetically modified organisms (GMOs), i.e., 1) about half of the surveyed population had negative attitude towards GMOs, 2) every tenth respondent had never heard of GMOs, 3) even 25% of the respondents were indecisive, 4) only 2% of the surveyed Lithuanian population was positive on the issue.

Overall, Lithuanian respondents were often unaware or had no opinion on certain issues related to GMOs. This was confirmed by the fact that almost half of the respondents indicated that they were ill-informed about GMOs and GMPs, 10.3% of survey participants expressed no interest in getting such information.

"Spinter" survey (February-March 2009). In 2009, "Spinter" (the public opinion and market research company in Lithuania) was commissioned to perform a secondary survey on GMOs and GMPs amongst Lithuanian population by applying the same Omnibus method. The results of the study served as a basis for comparison with the findings of the 2007 data, which suggested that the popularity of GMO topic in the Lithuanian society was getting a momentum. In 2009, the "Spinter" survey disclosed the declining share of respondents who had no opinion on various issues related to GM products, especially on the topic of GMPs penetration rate in to the Lithuanian market. The number of indecisive and neutral respondents dropped considerably, as well as the proportion of consumers' doubts as to whether they were buying and consumption GM foods (in 2007, the Lithuanian respondents expressed a much stronger negative position).

"Spinter" research data indicated that the regulation of GMOs in respect of the society is not yet fully developed and measured. The prevailing number of respondents believed that GMOs had crucial impact on human health; therefore, the predominantly negative attitudes concerning GMOs and the use of GMOs in Lithuania dominate. This outcome was related to inadequate levels of knowledge and mistrust of what was unfamiliar, or with a reasonable assessment of the phenomenon. This assumption was confirmed by the observed neutral position of the respondents, expressed as an increasing part of different socio-demographic groups in the study due to the inconsistency of their opinions (observed in both "Spinter" studies of 2007 and 2009).

Locals also tended to agree that they were not sufficiently informed about GMOs and GM products (c.f., *43% of surveyed people claimed that there was not enough information, 36% of respondents indicated that they were a little aware on the subject, but they would like to get more information*). There is a decrease in total indifference to GMOs and GMPs amongst the Lithuanian population. Thus, increasing interest in genetically modified foods was detected by the fact, compared to 2007; the survey participants indicated they needed more detailed information, concerning GMOs and GMPs (especially when highlighting their awareness for information needs in health-related effects of GMOs). More and more people were expressing confidence in the information provided by professionals: scientists or general practitioners. In general, the least trusted organisational groups as indicated by surveyed Lithuanian respondents were a) vendors, and b) government agencies.

The same trend was also reflected in the assessment of confidence in public institutions – (as indicated in 2007) the largest consumer protection organizations retained the

consumers' confidence though other organizations, like *Greenpeace* and related green initiatives were falling in confidence. At the same time, increasing confidence was more directly attributed to organic food organizations, namely a) associations of organic farming and b) farmers' organizations.

The Ministry of Environment survey (2010). In 2010, the *Ministry of Environment* conducted research and planned allowing the use of genetically modified organisms on the social and economic environment of Lithuania. According to this study led by Dr. R. Lazutka, genetically modified (GM) products were still considered very controversially not only in Lithuania, but also across Europe.

The economic assessment of GMPs is associated with their market value in the country – namely, *quantity, quality and price*. According to the Ministry's survey, the country's commercial networks offer GM products at the prices about one-third lower than conventional products. For example, GM oil is less expensive on average by 37.7%, GM margarine and butter products – by 30.8%. Lithuanian population consumes about 1,800 tons of GM oil for the value close to 11 million *Litas* per month. The country has increased production of GM feed as well. In 2008, they produced 10.1% more of GM feed for animals than in 2007, comprising the total of 352,625 tonnes of GM feed. As shown by the Ministry's survey, about half the Lithuanian consumers had negative perception on of GMOs and GMPs. Slightly more than half of the surveyed did not know or were not sure whether they had ever purchased or consumed GM products. Almost 40% of respondents stated that GM products were purchased because they were *cheaper*. Majority of the surveyed Lithuanian population believed that stores and supermarkets should package and place GM products on *separate shelves with clear indication of the products' origin*. Others wanted *labelling on these products more pronounced, and information about them printed in bigger type*.

“Spinter” survey (2010). In 2010, „Spinter” conducted another national survey in Lithuania called *“National public opinion on genetically modified organisms in research”*. The Omnibus research approach was applied again to obtain the data. The objective of the study was to figure out the attitudes of the country's population towards genetically modified organisms.

The results showed that public opinion on GMOs was becoming increasingly negative. GMOs as a subject were also becoming increasingly familiar amongst the Lithuanian population. An increasing number of participants expressed a clear opinion on the GMO in respect of (as compared to 2009 survey):

- Increased respondents' awareness of GMOs (88% in 2009 and 96% in 2010).
- Popular attitude that GM crops were grown for scientific purposes in Lithuania (28% in 2009 and 32% in 2010).
- A growing number of respondents believed that GM crops could also differ from natural counterparts (22% in 2009 and 28% in 2010).
- Another perception was getting momentum amongst the surveyed Lithuanian consumers that farming animals were fed with GM feed (in the case of animals raised abroad, 42% of Lithuanian respondents were positively convinced on the fact of GM feed was used in raising livestock; in the case of farming animals raised in Lithuania, the proportion was considerably lower, i.e. 24%).

- Surveyed population were more indifferent as it used to be in 2009 towards GM products' impact on human health (down from 24% in 2009 to 14% in 2010).

Higher yield (77%) and lower power consumption (21%) are identified as the main reasons why the GM crop plots in the world are on the increase every year. Responses of survey participants indicated that the negative attitudes in society towards GMOs are increasing.

In 2010, respondents indicated more directly about the need for information on GMOs and GMPs (43% of respondents in 2009 and 50% in 2010), as they reported being ill-informed about GMOs and GM products. Compared to 2009 Survey, the 2010 Survey's participants generally named their preferences for larger in scale and more diverse types of information and advertising on GMOs in need. Recently, TV (takes 67% of all mass media market in Lithuania) is becoming a major source of information about GMOs. The growth of the Internet importance is not underestimated as its significance for Lithuanian consumers increased from 24% in 2009 to 32% in 2010. The most reliable sources of information remain as indicated by Lithuanian consumers:

- scientists (36%),
- doctors and general practitioners (25%),
- mass media (16%).

Comparing the survey results, we can state that the Lithuanian public opinion about GM products is more negative than positive. Currently, it is difficult to detect GM foods in the range of ordinary foods in Lithuanian supermarkets. The consumer should carefully study the small script information labels, which indicate the composition of a product. The "Spinter" Survey (2010) stated that as many as 42% of Lithuanian respondents indicated that the presence of GMOs in purchased supermarket products was only discovered upon arrival home and reading closer in tiny script at the bottom of product labels. So it only reaffirms that the GM food labelling system should be readjusted for consumers' convenience.

4. Empirical research on prices for GMP and conventional products in the Lithuanian major supermarkets

As indicated in the literature review and secondary surveys overview, GMPs are generally made from genetically modified plants. Production from genetically modified plants costs much less than production from conventional plants, as the harvest is easier and they are drought-, water-, and parasite-resistant.

Supermarkets in Lithuania sell conventional and genetically modified products (GMPs). They are in the same outlets, unmarked shelves, labelling is not unique.

The observation method was used by the authors of the paper to indicate the variances in pricing for conventional and GM oils and fat spreads in Autumn 2011 (20-30th September). *The purpose of the survey* was to detect the potential consumers' sensitivity to pricing policies of conventional and GM products in the range of oils and fats offered at five major Lithuanian supermarkets, namely "Maxima", "IKI", "Prizma", "Norfa" and "RIMI". The price range in GM oils and margarines and spreadable fats is listed in table no. 3. It also shows the nominal and average prices.

Table no 3: Genetically modified and conventional products compared in Lithuania
(prices in LT)

Shopping centre/ supermarket:		MAXIMA	IKI	PRIZMA	NORFA	RIMI	Average price of conventional products (without GMO)
Product	BRAND NAME:	GMP PRICE					
OIL (II)	„Augalinis aliejus“			-	5.59		7.93
	„Brolio“	5.99		-	6.99		
	„Optima Linija“	5.89		-			
	„Oilio“	7.99		6.99			
	„Omili“			6.29			
	„Perla“		5.29	-			
	„Cento“		5.99	-			
	„Sodžiaus“			-	6.99		
	„Flarina“			-	5.89	5.79	
	„Kolumbo“			-	5.29		
	„Virtuosso“			-	5.89		
MARGARIN E, FAT SPREADS (200gr)	„Aima“			2.19			4.09
	„Optima Linija“	3.49		-			
	„Riebalų tepinys 25% riebumo“			-	1.89 (400gr)		

Note: All prices are in the local currency Litas (LT), where 1 euro = 3.45 LT.

Source: compiled by the authors during the observation survey in Autumn 2011 (based on products available at supermarkets, located in Kaunas City, Lithuania).

As table no. 3 indicates, GMPs are usually cheaper than conventional products. Lithuanian consumers are willing to purchase products, containing GMOs, due to price competition. Prices for GM oils in Lithuania are 23% cheaper as compared with conventional oils; margarine and spreadable fats are priced even 38% less than conventional counterparts. The economic slowdown in the Lithuanian market suggests that local consumers tend to choose less expensive products (Vitkauskaitė, 2011), despite their perceived harmful impact on human health (Grundey, 2009).

Conclusions

The number of genetically modified products (GMPs) and their varieties have increased significantly on the Lithuanian market. From 2007 to 2011, the amount of GMPs increased more than 4.6-fold. Genetically modified products are positioned alongside conventional products in supermarkets, without clear indication of its origin and labelling is not unique. All five surveyed biggest supermarkets in Lithuania (*Maxima*, *IKI*, *Prizma*, *Norfa* and

RIMI) sell products containing GMOs, especially cooking oils and fat spreads, mayonnaise, and other products containing GM soybeans.

The overviewed studies on consumers' perception and attitudes towards GMOs and GMPs, indicate that Lithuanian consumers' opinion about GM products was negative and getting worse due to more disturbing information on GMPs was available. The 2010 "Spinter" Omnibus study showed that even 42% respondents indicated that the presence of GMOs in purchased supermarket products was only discovered upon arrival home and reading closer in tiny script at the bottom of product labels. Lack of information about genetically modified organisms and genetically modified products, as well as their impact on human health were major concerns for Lithuanian consumers in performed longitudinal surveys in 2007, 2009 and 2010.

Comparing the prices of genetically modified products with conventional ones in Lithuanian supermarkets, visible difference in pricing was observed in Autumn 2011. Genetically modified products were less expensive than conventional counterparts. Prices for GM oils were 23% lower compared with the conventional oils; margarine and spreadable fats were even 38% cheaper than conventional ones. The economic slowdown situation in the Lithuanian market suggested that consumers tended to choose less expensive products. It is, therefore, appropriate to develop information system to provide consumers with knowledge on genetically modified products and suggest ways to change the labelling of genetically modified products in the system.

References

- Abdalla, A. et al., 2003. *Agricultural Biotechnology: Potential for Use in Developing Countries*. [pdf] Canberra: ABARE. Available at: <http://adl.brs.gov.au/data/warehouse/pe_abarebrs99000992/PC12594.pdf> [Accessed 12 August 2011].
- Abugelis, R., 2006. Genetiškai modifikuoti augalai – nauja era žemės ūkio istorijoje. *Mano ūkis*, Iss. 9, pp. 40-42.
- Aleksynas, A., 2006. Daug triukšmo dėl genetiškai modifikuotų organizmų. *Mano ūkis*, Iss. 11, pp. 34-37.
- Batiuskaitė, D., 2007. *Genetiškai modifikuoti organizmai*. [pdf]. Kaunas: VDU. Available at: <<http://molbio.vdu.lt/medziaga/GMO.pdf>>. [Accessed 12 August 2011].
- Clive, J., 2009. *Global Status of Commercialized Biotech/GM Crops: 2009*. ISAAA Brief No.41. [pdf] USA: ISAAA AmeriCenter. Available at: <<http://www.isaaa.org/resources/publications/briefs/41/download/isaaa-brief-41-2009.pdf>> [Accessed 22 September 2011].
- Gaidamavičius, A., 2007. Laisvę Lietuvai nuo GMO! *Žaliojo Lietuva: Žaliosios minties laikraštis*, Iss. 7, pp.1-3. [pdf]. Available at: <http://www.zaliojilietuva.eu/wp-content/uploads/zl_archyvas/277.pdf> [Accessed 9 January, 2012].
- Grinius, L., et al., 2007. *Genetiškai modifikuoti organizmai (GMO): jų poveikis aplinkai, žmonių bei gyvūnų sveikatai ir ekologiškai švaraus maisto gamybai. Moderniosios biotechnologijos saugaus naudojimo ir vystymo perspektyvos Lietuvoje*. Vilnius: Petro ofsetas.
- Grundey, D., 2003. Sustainable Consumption and Green Marketing: Transforming Consumer Behaviour. *Transformations in Business & Economics*, 2 (1), pp.20-47.

- Grundey, D., 2009. Eco-Marketing and Eco-Labeling: Does it Ensure Customer Loyalty in Lithuania?. *Transformations in Business & Economics*, 8 (1), pp.152-179.
- Grundey, D., et al., 2004. Competing in Food Technologies: Transition to Sustainable Consumption Patterns and Ethics. *Transformations in Business & Economics*, 3(2), pp.58-78.
- Knight, J.G., et al., 2007. Acceptance of GM food—an experiment in six countries. *Nature Biotechnology*, Iss. 25, pp. 507–508.
- Lietuvos respublikos genetiškai modifikuotų organizmų įstatymas. 2001 m. birželio 12 d., nr. IX-375. *Valstybės žinios*, 2006-07-14, nr. 77-2967.
- LR valstybinė maisto ir veterinarijos tarnyba, 2009. *Patikslintas prekyboje esančių maisto produktų, kurių sudėtyje yra genetiškai modifikuotų organizmų, sąrašas*. [pdf] Vilnius: LR valstybinė maisto ir veterinarijos tarnyba. Available at: <<http://www.vet.lt/lt/pages/view/?id=458>> [Accessed 19 October 2009]
- LR valstybinė maisto ir veterinarijos tarnyba, 2010. *Patikslintas prekyboje esančių maisto produktų, kurių sudėtyje yra genetiškai modifikuotų organizmų, sąrašas* [pdf] Vilnius: LR valstybinė maisto ir veterinarijos tarnyba. Available at: <<http://www.vet.lt/lt/pages/view/?id=458>> [Accessed 19 July 2010].
- LR valstybinė maisto ir veterinarijos tarnyba, 2011. *Patikslintas prekyboje esančių maisto produktų, kurių sudėtyje yra genetiškai modifikuotų organizmų, sąrašas* [pdf] Vilnius: LR valstybinė maisto ir veterinarijos tarnyba. Available at: <<http://gmolt.wordpress.com/2011/07/29/patikslintas-prekyboje-esanciu-maisto-produktu-kuriu-sudetyje-yra-gmo-sarasas/>> [Accessed 29 July 2011].
- Marinez-Campillo, A., and Fernandez-Gago, R., 2011. What about the Effects of Increasing Diversification in Response to Environmental Transformations? The Case of Spain. *Transformations in Business & Economics*, 10 (1), pp.148-165.
- McHuguen, A., 2000. *Biotechnology and food*. New York: American council on science and health. USA: American Council on Science and Health. [pdf]. Available at: <http://www.acsh.org/docLib/20040401_Biotechnology2000.pdf> [Accessed 12 August 2011].
- Melnikas, B., 2011. The Global Transformations, Sustainable Development and the Knowledge Based Society Creation: The Perspective Theoretical Approach. *Transformations in Business & Economics*, 10 (2), pp.151-167.
- Miron, D., Petcu, M. and Sobolevski I.M., 2011. Corporate Social Responsibility and the Sustainable Competitive Advantage, *Amfiteatru Economic*, XIII (29), pp.162-179.
- Moschini, G., 2008. Biotechnology and the Development of Food Markets: Retrospect and Prospects, *European Review of Agricultural Economics*, Iss. 35, pp. 331-355.
- Murphy, A.M., et al., 2007. *Agricultural Biotechnology to 2030: "Steady Progress on Agricultural Biotechnology" Scenario* [pdf]. Wageningen (Netherlands): CTA. Available at: <<http://www.oecd.org/dataoecd/12/57/40920458.pdf>> [Accessed 12 August 2011].
- Paulauskas, A., 2004. *Genetiškai modifikuoti organizmai*. Vilnius: Petro ofsetas.
- Rousu, M.C., et al., 2007. Effects and value of verifiable information in a controversial market: evidence from lab auctions of genetically modified food. *Economic Inquiry*, Iss. 45, pp.409–432.

- Šalies gyventojų tyrimas dėl požiūrio į genetiškai modifikuotus organizmus, 2007. *Reprezentatyvi gyventojų apklausa* [pdf]. Vilnius: Spinter tyrimai. Available at: <gmo.am.lt/viewfile?show=gmo_sprinter%20tyrimas_2007_119978950236948208.ppt> [Accessed 19 October 2009].
- Šalies gyventojų tyrimas dėl požiūrio į genetiškai modifikuotus organizmus, 2009. *Reprezentatyvi gyventojų apklausa* [pdf]. Vilnius: Spinter tyrimai. Available at: <http://gmo.am.lt/viewfile?show=prezentacija-gmo200903_123807288508060639.pdf> [Accessed 19 October 2009].
- Šalies gyventojų tyrimas dėl požiūrio į genetiškai modifikuotus organizmus, 2010. *Reprezentatyvi gyventojų apklausa* [pdf]. Vilnius: Spinter tyrimai. Available at: <<http://gmo.am.lt/page?page=view&format=frontend&id=9472fcb6-b5a2-4db6-b767-bd70396cef0b>>. [Accessed 19 July 2011].
- Stanys, V., 2009. *Ar galima pasitikėti genų inžinerijos produktų rizikos įvertinimu? Biotechnologijos saugaus naudojimo ir vystymo perspektyvos Lietuvoje*. [pdf]. Vilnius: Inforastas. Available at: <http://gmo.am.lt/viewFile?show=Tezes_123814698107860646.pdf>. [Accessed 14 October 2011].
- Toming, K., 2007. The Price Impact of Adopting the Common Agricultural Policy in Estonia: Estimated and Actual Effects. *Transformations in Business & Economics*, 6 (2), pp. 133-152.
- Vitkauskaitė, V., 2011. *Lietuvos pirkėjo portretas: taupus, bet smalsus*. [pdf]. Vilnius: IQ Ekonomika ir verslas. Available at: <<http://iq.lt/titulinis/lietuvos-pirkejo-portretas-taupus-bet-smalsus/>>. [Accessed 15 October 2011].